Docker Project Virtualization 1

Analyzing LHC data with the help of a docker container: The task is to measure the mass of the Z-Boson.

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Goal of the project:

Analyzing LHC data with the help of a docker container. The task is to measure the mass of the Z-Boson.

At `http://www.atlas.uni-wuppertal.de/~harenber/masses.txt`

You will find a data file containing 1919 invariant masses (in GeV) of a two electron system from a Z→ee decay.

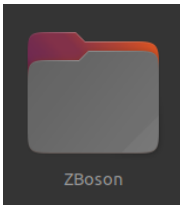
This data needs to be filled into a histogram, see `http://en.wikipedia.org/wiki/Histogram` for a definition of histograms (see "mathematical definition").

The following steps are required for a successful measurement:

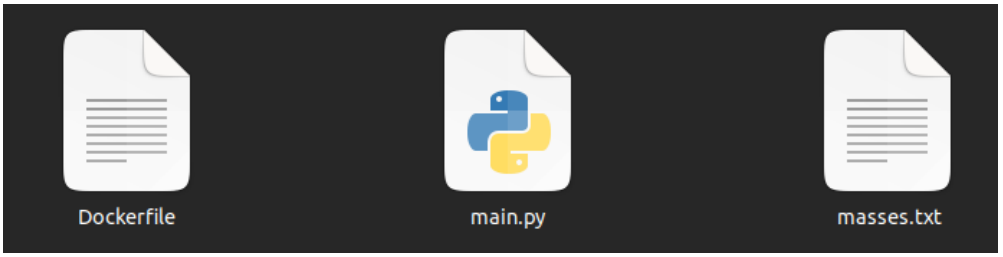
- Download the file.
- You now need to histrogramize the data, create a histogram with 150 bins from 0 to 150 GeV.
- Find the bin with the highest value. The x-value of that bin is your Z boson mass measurement.
- As comparison to that method, do a gaussian fit of the distribution and find the maximum. How does this value differ from the previous value? What is the influence of the number of bins chosen for the histogram?
- Try to visualize your data with some kind of graphical representation.
- Write out the results into a bind-mount volume.

The implementation of the project.

1) Create a directory **ZBoson** on the local machine.



2) Add three files namely *'main.py'*, *'masses.txt'* and *'Dockerfile'* in the **ZBoson**.



3) On my local machine, the path of the ZBoson directory is `/home/djm/ZBoson`

4) You may use the following command,

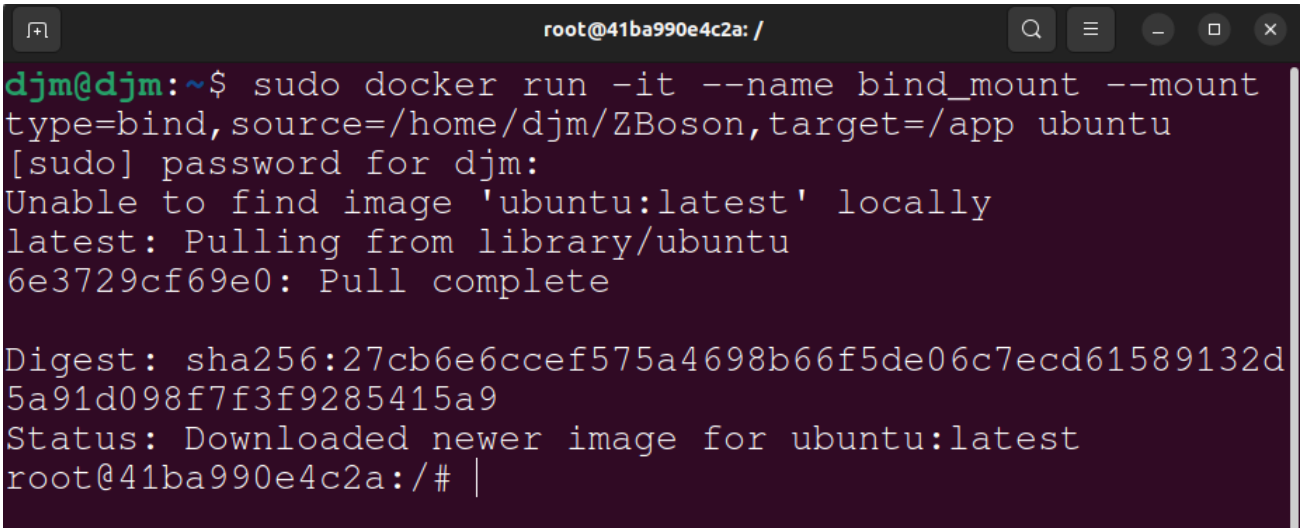
```
$ sudo docker system prune -a
```

To avoid any possible conflicts with other images and containers.

5) Run the following command in the terminal,

```
$ sudo docker run -it --name bind_mount --mount type=bind,source=/home/djm/ZBoson,target=/app ubuntu
```

This command bind mounts the host directory `/home/djm/ZBoson` to the directory `/app` inside an ubuntu container.



6) After running the command in step (5), you will find the root prompt inside an ubuntu container.

```
root@41ba990e4c2a:/#
```

Type `ls`

```
root@41ba990e4c2a:/# ls
```

You will see the `/app` directory,

Now type, `cd app`

```
root@41ba990e4c2a:/# cd app
```

Again type, `ls`

```
root@41ba990e4c2a:/app# ls
```

You will see three files from the bind mount directory `/home/djm/ZBoson`

Dockerfile main.py masses.txt

```
root@41ba990e4c2a:/app# ls
Dockerfile  main.py  masses.txt
root@41ba990e4c2a:/app#
```

Please keep this terminal open.

7) In this step, we will create a Docker container for *`main.py`*.

   Now open a new terminal window in the host directory, `/home/djm/ZBoson`.

8) Run the following command in the host directory, `/home/djm/ZBoson`.,

   ```
   $ sudo docker build -t zboson .
   ```

   ```
   djm@djm:~/ZBoson$ sudo docker build -t zboson .
   ```

   This command builds an image **zboson** from Dockerfile in the same directory (`/home/djm/ZBoson`)

   Now time to check the image **zboson,**

   Run the following command,

   ```
   $ sudo docker images
   ```

   You will see the following output in the terminal,

   ```
   Successfully built 68777ef0e1b3
   Successfully tagged zboson:latest
   djm@djm:~/ZBoson$ sudo docker images
   REPOSITORY   TAG       IMAGE ID       CREATED          SIZE
   zboson       latest    68777ef0e1b3   40 seconds ago   1.31GB
   python       3.11      afe5735f16e1   6 days ago       932MB
   ubuntu       latest    6b7dfa7e8fdb   5 weeks ago      77.8MB
   djm@djm:~/ZBoson$
   ```

9) Since the output of *`main.py`* is two images and two text files.

   We map the directory `/usr/src/app` inside the container **zboson** to the host directory

   `/home/djm/ZBoson`.

   Now we run the most important command,

   ```
   $ sudo docker run -v /home/djm/ZBoson:/usr/src/app zboson
   ```

   ```
   djm@djm:~/ZBoson$ sudo docker run -v /home/djm/ZBoson:/usr/src/app zboson
   ```

9.1) This command runs docker image **zboson** and saves the output in the host directory `/home/djm/ZBoson`

10) Now you will see two images and two text files *EffectOfBinSize.png*, *histogram.png*, *MaxBinValueHistogram.txt*, *MaxBinValueGaussian.txt* in the host directory `/home/djm/ZBoson`. In the terminal window. You can also see the output of the `main.py`

```
djm@djm:~/ZBoson$ ls
Dockerfile              masses.txt
EffectOfBinSize.png     MaxBinValueGaussian.txt
histogram.png           MaxBinValueHistogram.txt
main.py
djm@djm:~/ZBoson$
```

11) Due to the bind mount `/home/djm/ZBoson` being linked with the directory `/app` inside an ubuntu container.

If you type `ls` in the ubuntu container window (commands from step 6)

`root@41ba990e4c2a:/app# ls`

You will see all files from `/home/djm/ZBoson`,

```
root@41ba990e4c2a:/app# ls
Dockerfile                  histogram.png
EffectOfBinSize.png         main.py
MaxBinValueGaussian.txt     masses.txt
MaxBinValueHistogram.txt
root@41ba990e4c2a:/app#
```

END